

HOW TO PROTECT WHEAT: SOME NOTES ON FUNGUS PESTS.

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In a time of wheat shortage throughout the world, every quarter grown in Britain is a national asset. There are two methods of augmenting the supply:—(1) by enlarging the area under cultivation, and (2) by increasing the yield per acre. The importance of the former cannot be urged too strongly. It is paramount. The possibilities of the latter are perhaps not always fully realised. Cultivation, fertilisers, and varieties materially affect the yield, and there is another factor equally powerful in making for increased supplies, namely, the control of fungus diseases.

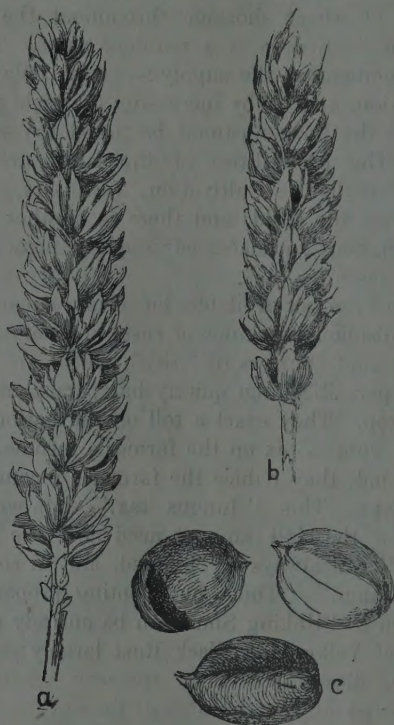
Exact figures are not available, but it is a lamentable fact that through the insidious workings of rusts and smuts alone several hundred thousand quarters of British wheat are lost annually. Each season parasitic fungi quietly but persistently steal a portion of the crop. They exact a toll on the nation's wealth and impose, as it were, a tax on the farmer's income. Whether he realises it or not, they reduce the farmer's income and rob him of his profits. This "fungus tax," however, should be contested, for the full amount need never be paid. A large "abatement" can always be obtained, and in some cases complete "exemption." Thus, by adopting proper measures an attack of Bunt or Stinking Smut can be entirely prevented, and the amount of Yellow and Black Rust largely reduced.

Though the diseases of wheat are very numerous, the most serious in this country at the present time are perhaps the three referred to above. Reliable preventive measures, already known to many farmers, have been found, and it is the object of this article to bring them to wider notice. If the advice here offered is taken, wastage of the 1921 crop through their ravages will be reduced to a minimum. As a result the farmer will reap a better harvest and will be able to present an additional contribution to the much needed general wheat supply.

Bunt or Stinking Smut.—In Bunt the ear appears normal, but the grains when broken are found to contain merely a mass of black spores which smells like putrid fish. The wheat plants are infected in the seedling stage, but for a long time hold their own and develop normally. Finally, however, the fungus wins,

completely destroying every grain in the ear and producing a mass of spores wherewith to propagate itself next season.

From reports furnished to the Ministry's Plant Disease Survey Office it would appear that in 1919 Bunt was more prevalent than usual, especially in the North and West Midlands. Particularly bad cases were also noted in Worcestershire and



a and *b*. Bunted ears. *c*. Bunted grain, containing black mass of bunt spores (magnified about four times).

Buckinghamshire; "Browick" was severely attacked in Herefordshire, "Victor" in Somerset and Devonshire, whilst "April Bearded," so extensively grown in the late districts of the West Midlands, Monmouth and South Wales, was very generally badly bunted.

Bunt may be prevented by "pickling" or treating the seed with a fungicide. In most of the best wheat districts proper pickling is regularly practised, and the crop, as a result, is clean. Where Bunt is present, inquiry has invariably shown that either no treatment was given or, if given, ineffective substances were

employed. The Ministry recommends *one or other of two substances only*, viz., copper sulphate (blue-stone) and formaldehyde. Other substances are commonly used, but these are for the most part useless. It should also be noted particularly that no substance has been discovered which affords protection from both birds and Bunt.

The secret of success in Bunt control lies in:—(1) the use of proper chemicals; (2) care in the method of pickling; and (3) the prevention of subsequent contamination by the admixture of untreated seed. It has been repeatedly proved that if these points are attended to complete elimination of the disease, even under farm conditions, can be obtained.

Treatment.—Even if there is no evidence that Bunt is present all doubtful seed should be pickled. For treatment with blue-stone the pure copper sulphate should be obtained, and a solution made at the rate of 1 lb. of copper sulphate to 10 gallons of water. The seed may either be thoroughly wetted with the solution on the barn floor, or steeped in a barrel for one to two hours, and afterwards spread out to dry. The formaldehyde method is, if anything, more satisfactory. With this substance 1 pint of commercial formalin (=40 per cent. solution of formaldehyde) is diluted with 20 gallons of water. (Smaller quantities may be prepared at the rate of two teaspoonfuls of formalin to 1 gallon of water.) The pickling solution should be thoroughly stirred before using, and should be applied to the grain in the same manner as the copper sulphate. If the steeping method is employed 20 minutes is sufficient, and the grain should be spread out afterwards to dry. (For full details see Leaflet No. 92.)

Yellow Rust. — The fungus causing Yellow Rust (*Puccinia glumarum*) is by far the most prevalent of all the wheat-attacking fungi in Britain. It is present to a varying extent every season even in the best wheat-growing areas, and in the case of most varieties probably occurs in every field. The disease is recognised by the innumerable, bright yellow spots or “sori” on the leaves. These sori contain a golden powder, the spores of the fungus which spread the disease. Sometimes the lower leaves only are attacked, but the upper ones often suffer also, the fungus spreading further to the ears and even to the grains. Owing to Yellow Rust being a “leaf rust” its effects are not so striking or disastrous as those of the “Black Rust,” which is a “stem rust,” and hence the damage inflicted is not always realised. The loss in the aggregate, how-

ever, is startling. Professor Biffen, in his essay on "Systematised Plant Breeding,"* writes with regard to this disease "what this (toll) amounts to on the average it is impossible to say at all definitely, but an estimate of from 5 to 10 per cent. is probably not very wide of the real figures." Applying even the lower figure to the year 1919, when 2,370,367 acres were under wheat, the amount lost by Yellow Rust (at an average of 4 quarters per acre) would be over 450,000 quarters. An allowance, however, must be made for resistant varieties.

The fact which every farmer should realise is that *this loss of crop is largely preventable*. There exist some good wheats which are very suitable for use in this country and are highly resistant to Yellow Rust. By the growing of these wheats the fungus is outwitted and the crop benefits in proportion. The three wheats resistant to Yellow Rust are "Little Joss," "Yeoman," and "Swedish Iron," the first two being raised by Professor Biffen at Cambridge. Unlike the susceptibility of potatoes to Wart Disease, where certain kinds are absolutely immune, these wheats sometimes show, specially early in the season, traces of Rust. They are, however, highly resistant, and always stand out in striking contrast to other sorts. No specially resistant spring wheat has yet been raised. In all districts where winter wheat is grown and Yellow Rust is prevalent, one or other of these varieties should be tried. Notes on their characters and their suitability for different areas are given below. Further advice may be obtained from the local Agricultural College.

"*Little Joss*."—An excellent all round, red wheat of good quality; it tillers freely and matures early. It is particularly suitable for light and poor soils, late districts and exposed situations, but is not good for land which is cold and wet in winter.

"*Yeoman*" is a new wheat with short, stiff straw. It possesses high-yielding and first-class milling properties, and can be grown on almost all classes of soil. It does extremely well south of the Thames.

"*Swedish Iron*" is a stiff-strawed, large-grained wheat suited for good land in a high state of cultivation. It does well in the north and cooler parts of the country.

Black Rust.—*Puccinia graminis*, the Black Rust fungus, is without doubt by far the most serious of all wheat parasites. This is this fungus which causes the devastating epidemics in India, Australia, and America, and it is, in fact, liable to occur in epidemic form in any country where it exists. As an example

* "Science and the Nation," Cambridge, 1917.

of the damage this minute organism can bring about it may be noted that in 1916 it was responsible for the loss of 100 million bushels in the three prairie provinces of Canada, and in the United States of over 200 million bushels in North and South Dakota, Montana, and Minnesota alone. Fortunately for Britain, Black Rust of wheat is exceedingly rare in our islands, and has been regarded as practically non-existent. During the past few years, however, its occurrence in a certain district in Pembrokeshire has been observed, and inquiry has shown that the attack is of several years' standing, and extends over a wider area than was at first thought. A special survey was commenced last autumn, conducted jointly by the Agricultural Department of the University College at Aberystwyth and the Ministry of Agriculture. From the results obtained by the Survey it appears that Black Rust in severe form now occurs annually over the whole of Pembrokeshire, Carmarthenshire and South Cardiganshire. The disease is locally termed "blast," and its appearance is often considered to be due to bad weather. The damage caused has been very severe. The fungus particularly attacks the straw, which it often completely cripples, and on which the black streaks of spore-masses develop. Losses of over 50 per cent. are frequent, and in some cases the entire crop is ruined and is not worth threshing. Not a few farmers in South Pembrokeshire have entirely abandoned wheat growing.

Although south-west Wales is mountainous and not a wheat growing country, the amount grown is highly commendable and is a material contribution to the nation's supply. The figures for 1919 are:—Cardiganshire, 7,208 acres; Carmarthenshire, 11,421 acres; Pembrokeshire, 3,484 acres. If proper measures be taken the yield from these 22,000 acres may probably be doubled.

The Barberry Menace.—Unlike Yellow Rust, Black Rust has a second host-plant, namely, the common Barberry, on which it occurs very widely. The injurious effect of Barberry on wheat has been known to farmers for upwards of two centuries. They affirmed, in spite of opposition, that it led to attacks of Black Rust, and subsequent investigation showed that they were right, the scientific proof and explanation being obtained many years later. The survey in Wales shows that the Barberry is generally and plentifully distributed in the three counties mentioned, occurring around the homestead and in the hedges. The fungus is found on the Barberry leaves in the spring in the form known as the "cluster-cup." Stretches of Barberry 100 yards long have been noted in lanes and on the roadside, sometimes covered

with the "cluster-cups" of Black Rust, from which spores were being discharged and blown in all directions. In another striking case a piece of Barberry hedge adjoined a wheat field, and the golden spores were being rained from the cluster-cups over very promising wheat. Isolated bushes of Barberry occur in other parts of England and Wales, but not to anything like the same extent.* The explanation of these severe attacks of Black Rust in the south-west of Wales is therefore clear; they are largely, if not entirely, due to the presence of Barberry. A full and illustrated account of this outbreak will be published shortly in the Ministry's *Journal*, but the present opportunity is taken of pointing out the danger so that every effort may be made to exterminate the shrub.

Although other factors may be concerned, there can be no question that the Barberry is the offender. The same shrub accounts for the enormous losses in the United States and Canada. A native of Europe and Asia, it has been planted in gardens in America and is now found wild along streams, rivers and roadsides. During the past few years the clearest evidence against the Barberry has been obtained in the Northern States. Each bush may commence a local outbreak, which serves as a centre from which the disease may, by means of its summer spores, spread for many miles. With a view to preserving the wheat crop an energetic Barberry campaign is now being carried out in Canada and in the United States. Similar campaigns have taken place in Europe. In Denmark, for instance, owing to the ravages of Black Rust, a law was passed in 1903 making the destruction of Barberry compulsory. From that date the disease commenced to die out, and is now practically non-existent.

No variety of wheat, suitable for use in Wales, can be recommended at present as immune to Black Rust. With a view to discovering whether any such wheat exists, over 70 varieties are being tested this season in Pembrokeshire and Cardiganshire. In the meantime attention should be concentrated on the Barberry. It should be rooted up, not merely cut down, wherever it occurs. Such a large number of bushes occur in the area that a determined and concentrated effort is needed. Every bush destroyed means a handicap on the spread of the fungus, and by energetic attack there is no reason why the fungus should not be eradicated, and as a result greatly increased wheat crops be secured.

* It should be noted that the Barberry which takes the Black Rust is the common or European Barberry, *Berberis vulgaris*. So far as is known, *B. Darwinii*, *B. stenophylla* and many other garden species do not become rusted.